Locke (Jos. M.)

REPORT

ON THE

ANALYSES OF THREE SPECIMENS

OF

MILK,

MADE AT THE REQUEST OF THE

HEALTH OFFICER OF THE CITY OF CINCINNATI,

BY

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JOSEPH M. LOCKE, C. E., Analytical Chemist.

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CHEMICAL ANALYTICAL LABORATORY,

265 WALNUT STREET, Cincinnati, Ohio.

October 12, 1870.

WM. CLENDENIN, M. D.,

Health Officer of the City of Cincinnati, Ohio.

SIR:

1 The City Milk Inspector having placed in my hands, by your order, three specimens of Milk for analysis, I have the honor to submit the following

REPORT:

2 METHOD OF ANALYSIS—That of Von Baumhauer was selected, which is as follows:

3 Having provided myself with a quantity of white sand, from St. Genevieve, Mo., it was boiled with hydrochloric acid, then washed in distilled water, thus removing all soluble matter, after which it was ignited in order to consume
4 all organic matter and remove moisture. Dried filters, equal in number to the analysis to be made. were then nearly filled with the pure sand and weighed, then ten (10) cubic centimetres of each of the specimens of milk were poured upon the filters previously numbered to correspond with those of the specimens; the sand was in sufficient quantity to hold the milk disseminated through it, the whole was then submitted to a temperature of about 60° C. (=140°F.) until apparently no more water was driven off, the temperature was then raised to 105°c. (=221°F.) which was continued until at successive weighings the weight of a filter and its contents remained constant; by deducting the weight of the filter and dried sand we obtained the
5 amount of solid matter, the loss of weight, after adding and

drying the 10 c. c. of milk, indicated the amount of volatile
6 matter. The filters were then drenched with anhydrous æther, dried and weighed, this second loss giving the
7 amount of fatty matter. (1) The dried filters, and their contents, were then drenched with hot water which removed the sugar of milk, soluble salts, and a very small portion
8 of the caseine; the filters and contents being dried and weighed, the difference of these weights and that of the
9 filters and pure sand, determined the amount of caseine. The amount of sugar of milk was determined by bringing the water with which the filters had been percolated to a volume of one hundred (100) cubic centimeters, then determining the amount of the solution required to reduce, in each case, two (2) c. c. of Fehling's tartrated-copper-test-solution. (2)

10 The mineral substances were determined from other portions of ten (10) c. c. dried and ignited in a crucible, then weighed, after which they were lixivated, thrown upon weighed filters, dried and reweighed in order to determine the amount of soluble parts.

11 In this method there are two important points to be observed: 1st. The sand wet with milk must not be heated much above 60 c. (=140 F.) before it is nearly dry, otherwise a part of the sugar is decomposed into caramel which in addition to the loss of sugar, renders the weighings difficult, as caramel is extremely hygroscopic. 2d. In lixiviating with hot water not more than 100 c. c. should be used, as that amount has been found by experiment sufficient to remove the sugar, and does not carry off with it a serious amount of caseine.

12 In the following tables will be found the results of five (5)

(1)The amount of fatty matter can not be exactly determined by evaporating the ætherial solution, obtained as a part of the fatty matter is carried off mechanically by the ætherial vapor, as is apparent by the escape of peculiar odor and white fumes.

(2)The determination of the sugar by the polariscope, I found to be impracticable for two reasons; 1st, on account of the variation, by heat, of the rotarary power of sugar of milk. 2d, the difficulty of obtaining a solution sufficiently clear for the length of column of liquid required.

analysis made in accordance with the aforementioned method. These tables are on page 21.

13 No. 345 (Laboratory number) Specimen of milk furnished Sept. 12th, 1870, by the City Milk Inspector, and marked by one (1) cut upon the bottle cork.

14 No. 346 (Laboratory number) Specimen furnished as above, and marked with two (2) cuts upon the bottle cork.

15 No. 347 (Laboratory number) Specimen furnished as above, and marked with three (3) cuts upon the bottle cork.

16 No. 348 (Laboratory number) Specimen of the first of the milking in the morning from a cow nine (9) or ten (10) years old which had calved in December, 1869, and had the privilege of running in pasture at all times, with additional food of cut hay and bran.

17 No. 349 (Laboratory number) "Strippings" from same cow and milking as No. 348.

18 The specimens were subjected to microscopic examination, Nos. 345, 346, and 347 being marked by great irregularity in size and shape of the fat globules, the reverse being the case in Nos. 348 and 349, but no importance is to be attached to this fact. (3)

19 The microscopic examinations were continued for several days upon specimens protected from and others exposed to the air, but in no case did I find any fungus vegetation or animalcula, and their existence in *pure* milk at any time is exceedingly doubtful, although the blueness of skimmed milk has been by some authors attributed to animalcula, and Essling reports the formation, in milk, within 24 hours after milking of fungus spores, just what is seen in most substances in a state of putrefaction. (4) Yet the skillful microscopist, J. B. Dancer, F. R. A. S.(5) renders the existence

(3) Von Baumhauer has shown that by placing in several bottles a quantity of the same sample of milk, then shaking the bottles unequal lengths of time, that upon subjecting the contents of the bottles to microscopic inspection, it will be found that the inequalities in size and shape of the fat globules, will be in accordance with the amount the bottle has been shaken, being the greatest in that which has been shaken the most.

(4) Journal des Connaissances Medical, and Journal de Pharmacie et de Chimié, Aug. 1869.

(5) See his paper read before the Manchester Literary Phil. Society, Nov. 30, 1869.

of such growths exceedingly doubtful, as he failed to find any such organized bodies in pure milk; the microscopic bodies sometimes found in town milk are, in his opinion, most probably introduced with the water used in diluting the same, although by exposing milk for five days in a damp closet, which he knew to be favorable to the formation of mould, fungus growth was produced upon the surface of the milk, *but no such formation could be found within the mass of the milk.*

20 The negative results of my own microscopic examinations were contrary to what I had anticipated, and were only admitted to myself after lengthened and persistent efforts to prove the contrary.

21 Nevertheless the microscope would be of service for the detection of pus, &c., when an abscess actually existed within the mammary gland.

22 There remains but one other observable characteristic to mention, viz. Specimen No. 346 exhaled a peculiar and decidedly fetid odor when first brought, although there was no indications of change in the milk as it did not coagulate until ten (10) hours afterwards.

23 The comparison of the results of the analysis of the three specimens of milk with the average results of analysis of good European milk are as follows:

24 No. 345, is a good article with rather a small relative proportion of sugar, the amount of each of the solid ingredients is rather small, thus indicating the milk to be somewhat dilute, that is, an excess of the watery portion.

25 No. 346. In this specimen the caseine is equal to the average amount, but it is deficient in sugar and especially so in butter, therefore a very poor article, a conclusion which its fetid odor corroborates.

26 No. 347. The large amount of solid matter (13.1 per cent.) in this specimen would lead one to the conclusion that it was of superior quality, but further examination shows the solid matter to be chiefly caseine, the quantities of sugar and butter being small, therefore it can be considered as a poor (not creamy) but "cheesy" milk.

27 No. 348 being the first of the milking is (as is known to all having charge of cows) the poorest milk the cow can yield, and much below what would be the average of the entire milking.

28 No. 349 being the "strippings" is above the average quality of the cow's milk, the difference between the first and last of the milking being but little in regard to the sugar and caseine respectively in each, as they are dissolved in the watery portion, but such is not the case in regard to the butter which in the "strippings" is an increase of 69½ per cent. of that yielded by the first milking.

29 In connection with this report upon the analysis of the specimens, I deemed it proper to make a series of examinations to determine.

30 1st. The value of the different methods of analysis.

31 2d. The amount of reliability of the various methods employed for the more rapid partial examination of milk for the detection of adulteration and "skimming."

32 3d. The *limit* and *extent* of the information derived from such examinations.

33 After having devoted over two (2) weeks to these investigations I received from Von Baumhauer, of Holland, (in reply to a telegram) a copy of his extended examinations, and conclusions upon the important subject of milk. (6)

34 A translated copy of which is herewith furnished; in making the translation I have preferred to retain much of the French construction of the author.

35 In these extended researches of Von Baumhauer I found many of the conclusions I had arrived at; these conclusions being frequently drawn from different courses of experiments and reasoning.

36 *Upon the value of the different methods of analysis* (see pars. 29 & 30).

37 Prior to the receipt of Von Baumhauer's pamphlet, I had by a careful consideration of the different methods, decided

(6) Méthod d'Analyse du Lait, par. E. H. Von Baumhauer. Extrait des Archives Néerlandaises, T. IV. 1869.

in favor of the one adopted in my analysis, on account of the exactitude of results, and great saving of time.

38 The method of analysis employed in the recent examinations of milk in New York City is defective, from the fact that the drying of the solid matter was not done at a temperature above 212° F. at which heat it will not part with all of its moisture, as I know by my own experience, corroboro-

39 rated by most authors upon the subject. The methods actually employed for the determination of the sugar, butter and caseine are not given, but in lieu thereof we have several methods enumerated, some of which are fallacious in their results, some impracticable and some reliable, hence for want of definate information we are unable to attach a proper value to the results.

40 M. Haidlen's Method, for objections thereto, see par. 30, translation of Von Baumhauer's paper. (7)

41 M. Wicke's modification of M. Haidlen's method, by substituting for gypsum sulphate of Baryta, is good, but not so convenient in manipulation as the one adopted.

42 Scherer & Dumas' Method only gives approximate results as in the dried solid matter, the caseine, will not impart all the fatty matter to æther.

43 M. C. Brunner's Method is very defective, see par. 30, trans. of Von Baumhauer's paper. (8)

44 To M. Otto we are indebted for the recommendation of the use of pure sand, which can be used in sufficient quantity to absorb the amount of milk subjected to analysis without its being of such a weight as to overload the scales, which is the objection to the use of sulphate of baryta.

(7) M. Haidlen's Method consists in adding to the milk, which is to be dried, one-fifth of its weight of dried pulverized gypsum, hence, if the gypsum has been previously too highly heated, it will have parted with a part of its water of crystalization, which is re-absorbed from the milk, and as it can not then be driven off, excepting by a heat sufficiently intense to decompose the solid matter of the milk, the true weight of the solid matter can not be obtained. Another source of error arises from the gypsum, not being insoluble in the water, employed to remove the sugar of milk and soluble salts.

(8) In this method coarsely pulverized charcoal is employed to mix with the milk, in order to facilitate its drying, but, as is well known, charcoal is far from being an indifferent substance toward organic substances, as is shown by its deoderizing and decolorizing property, hence the method should be rejected.

45 THE AMOUNT OF RELIABILITY OF THE VARIOUS METHODS EMPLOYED FOR THE MORE RAPID PARTIAL EXAMINATION OF MILK FOR THE DETECTION OF ADULTERATION AND "SKIMMING." (See pars. 29 and 31.)

46 A number of these proposed methods can be classed under the name of Chemical Methods, depending upon the chemical determination of the amount of one of the non-volatile constituents, as for example.

47 M. Marchand's Method, based upon the amount of fatty matter.

48 M. M. Reveil and Chevallier's based upon the amount of sugar.

49 M. L. Ladé's, based on the amount of caseine.

50 E. M. Monier's, based on the amount of caseine.

51 All of which are fallacious in their results, from the fact that there is no fixed relative proportion between the various substances composing the solid matter in different specimens of milk, consequently a knowledge of the amount of one of the constituent parts, conveys to us no idea of that of the others, nor does any one of the constituents have a constant quantity in all specimens of pure milk; furthermore, these methods are rendered less worthy of confidence, from the fact that the proposed methods for determining one of the constituent parts, are inaccurate.

52 The remainder of the methods under this head can be classed as the Mechanical Methods, viz:

53 By the density of the liquid, whether measured by the specific gravity bottle or by the areometer, whether having a scale of specific gravities or special division and designation as Chevallier's Gelactometre, the ordinary milk probe, &c., &c.; all of which give by themselves no positive information of the character of the milk for the following reason:

54 Milk is composed of a watery fluid in which is dissolved most of the solid matter, and consequently heavier than water, in which liquid is suspended lighter particles of fatty matter; this mixture necessarily has a specific gravity be-

tween the two, therefore in any specimen of milk "skimming" would increase the density of the remainder, which by the addition of water can be lowered to equal that of the milk in its original normal condition, and it is evident that this double falsification of the milk would not be indicated
55 by the above-named instruments; nor can any set density be assigned for pure milk, for we may have milk rich in the dissolved solid matters which on account of containing also a large amount of fatty matter will have a lower specific gravity than some poor specimen, vide the specimen of "strippings" No. 349 specific gravity—1031, and the poor milk No. 346 specific gravity—1033. Similar, and even greater disparity between the indications of the apparent value of milk by its density, and its actual value as shown by analysis, can be found in all tables of analysis; hence we
56 see how little value is to be attached to the indications of density alone, which can only accurately be determined for milk by means of the specific gravity bottle, as in the use of areometers small particles of butter are liable to collect under the bulb of the instrument and buoy it up, thus vitiating the
57 reading; furthermore, the density is required to be taken in all cases at one temperature as the variable composition of milk causes each specimen to have its own co-efficient of expansion, consequently no general table of correction for temperature can be constructed.

58 The next instrument we will examine is the galactometer or creamometre which consists of a tall jar with graduations upon it, each indicating one hundredth of its capacity, and numbered from the top downward. The jar being filled with milk to the upper mark is allowed to stand at rest in order that the cream may collect upon the surface, the per
59 cent. of which is then read off by the divisions. This instrument is liable to lead to error in the comparison of different samples of milk, especially in the richer milks, in which it is difficult for the cream to rise through so tall a
60 column of milk, (9) the instrument is especially unreliable in

(9) Johnston's Agricultural Chemistry Lecture, XX. p. 548.

the examination of milk which has been shaken, as in transportation upon carts; this was shown by taking several samples of the same milk, subjecting them to various amounts of shaking, then putting them into creamometers, also one sample of unshaken milk which gave an indication of 8¼ per cent. of cream, the others giving from 10 to 6 per cent. a discordance so great as to preclude its use. ([10])

61 The last instrument we will speak of is the gelactroscope of Donné, which depends for its action upon the measurement of the opacity of milk produced by the fat globules floating through it, but I am of opinion that the agitation of the milk, causing the coalescence of the fat globules, will effect the opacity to such an extent as to render its use of as little value as the creamometer. I am at present having constructed an improved gelactroscope with which to settle the point by actual experiments.

62 Before entering upon the discussion of the limit and extent of the information derived from the foregoing methods of examination, it will be necessary to draw attention to a few facts in order to establish the statement that the milk of an animal is quickly impressed by a variety of causes of entirely different character.

63 The character of the food has a great effect upon the amount of solid matter in the milk, and the relative proportion of its various constituents; carbonaceous food increases the proportion of sugar and butter, while nitrogeous diet has a like effect upon the caseine. ([11])

64 Many substances taken into the stomach make their appearance in the milk, as is familiarly known in the case of cattle eating rag weed, or wild garlic, which will impart even to the butter its peculiar flavor. M.M. Parmentier and Deyeux made a series of experiments, showing that the milk of cows were flavored by the food they ate. ([12]) If madder

(10) Translation of Von Baumhauer's paper, par. 21.

(11) See Bousingault's Experiments, Annals de Chimié et de Phy. LXXI. p. 76. Dr. Playfair's Experiments, Memoirs Chemical Society, I. p. 174. Johnston's Agricultural Chemistry Leeture, XXI. p. 606. Carpenter's Human Physiology, Phil. Edition 1860, p. 823. Traite de Chimié par Berzelins, Tom VII, p. 584. Encylopedia Britanica, Vol. XV. p. 73.

(12) Encylopedia Britanic, Vol. XV. page 75.

be given to cows the milk is red, if they eat saffron it becomes yellow,([13]) and many medicines administered to animals make known their existence in the milk; on this subject experiments have been made upon both the human and brute subjects. The influence of mercurial medicines, taken by the mother, in removing from the infant a syphilitic taint possessed by both is well known. ([14])

65 The peculiar stimulating effect upon the mammary glands of certain articles of food is well shown by the fact that cows have been kept in milk for three years by the use of Brewer's grain, &c. ([15])

66 As cows belong to the ruminantia, all of which are timid, nature has made provision for them to gather their food in haste, then to retire to some safe place in which they may quietly masticate and digest it, (chew their cud). As they collect their food, in their haste, they are liable to gather with their proper food violent poisonous vegetation, but nature has here again made provisions by so constituting the animals as not to be affected by the majority of these poisonous
67 substances. But do not the facts stated in paragraph 64 render it probable that the poisonous properties may appear in the milk and become evident when used by man,
68 who is not so protected from their effects? In further support of this idea may be mentioned the disease prevailing in some districts under the name of "milk sickness," which is now generally attributed to some vegetable substance eaten by the cows; it is not due to malaria as carniverous animals are never affected unless they drink the milk or eat the flesh of animals affected with the disease; it is not from the water as cows are affected in pastures, where there is no water and receive only drinking water known to be pure, and the only animals affected by the original cause are those that graze and browse, but their flesh and milk will reproduce it in all animals. Cows and sluts exposed to the poison during lactition, generally escape while their off-

(13) Johnston's Agricultural Chemistry Lecture, XX. p. 537.
(14) Carpenters' Human Physiology, Phil. Edition, p. 1860, page 824.
(15) Johnston's Agricultural Chemistry Lecture, XX. p. 541.

69 spring die. Does not this and paragraphs 64 and 66 strongly induce one to regard lactition as a powerful e iminating process for the removal of foreign and deliterious substances from the system?

70 The quality of milk is also effected by exercise as shown by the fact, well known in Switzerland, that cows pasturing in exposed places, requiring them to take much exercise, yield a milk rich in caseine but poor in butter, yet the same cows when stall fed yield milk rich in butter but poor in
71 caseine.([16]) This results from the muscular exertion, in the first instance, throwing off into the blood nitrogeneous matter which enters into the milk forming an increased amount of caseine.([17]) while the increased respiration takes up the carbonaceous matter, thereby reducing the amount of butter and sugar; in the stall but little nitrogeneous matter is thrown off, nor is much carbon consumed by respiration, consequently we have in the milk more carbonaceous matter (butter and sugar) but less nitrogeneous (caseine); this action would be enhanced by imperfect ventilation of the stable.

72 No secretion so strongly manifests the influence of the nervous system, and especially of emotional states, both upon its quantity and its quality as that of the mammary glands ([18]) and we are continually witnessing indications of
73 the fact "because *the digestive system of an infant is a more delicate apparatus for testing it, than any the chemist can devise:* affording proof by disorder of its functions, of change in the character of the secretion, *which no examination of*
74 *its physical properties could detect.*" ([19]) The following remarks on this subject are abridged from Sir A. Cooper's valuable work on the breast. "The secretion of milk
75 proceeds best in a *tranquil state of mind*, and with a cheerful temper; then the milk is regularly abundant, and agrees well with the child, on the contrary, a fretful temper

(16) Carpenters' General and Comparative Physiology, Phil. Edition 1851, P. 981.

(17) Pure butter, and sugar of milk are composed of Carbon, Hydrogen, Oxygen. Caseine contains in addition to the foregoing Nitrogen.

(18) Carpenters' Human Physiology, Phil. Edition 1860, page 741, par. 833.

(19) ib, page 742, par. 833.

lessens the quantity of milk, makes it thin and serous, and causes it to disturb the child's bowels, producing intestinal fever and much griping. *Fits of anger* produces a very irritating milk, followed by griping in the infant, with green stools, . . . *Anxiety of mind* diminishes the quantity and alters the quality, of the milk. . . Fear has a powerful influence on the secretion of milk. . . . . *Terror*, which is sudden, and great fear, instantly stops this secretion. Of this two, striking instances, in which the secretion, although previously abundant, was completely arrested by this emotion are detailed by Sir A. C." ([20])

76 "There is even evidence that the mammary secretion may acquire an actually *poisonous* character, under the influence of violent mental excitement; for certain phenomena which might otherwise be regarded in no other light than as simple coincidences appear to justify this inference, when interpreted by the less striking but equally decisive facts already mentioned. A carpenter fell into a quarrel with a a soldier billeted in his house, and was set upon by the latter with his drawn sword, the wife of the carpenter at first trembled from fear and terror, and then suddenly threw herself between the combatants, wrested the sword from the soldier's hand, broke it to pieces, and threw it away. During the tumult some of the neighbors came in and separated the men, while in this state of strong excitement the mother took up her child from the cradle, where it lay playing, and in the most perfect health, never having had a moment's illness: she gave it the breast and in so doing sealed its fate, in a few minutes the infant left off sucking, became restless, panted, and sank dead upon its mother's bosom. . . In this interesting case, the milk must have undergone a change which gave it a powerful sedative action upon the susceptible nervous system of the infant." ([21])

77 Similar facts are recorded by other writers, Mr. Wardrop mentions ("Lancet" No. 516) that having removed a small tumor from behind the ear of a mother, all went well

(20) Carpenters' Human Physiology, Phil. Edition 1860, page 472, par. 833.
(21) Carpenter's Human Physiology, Phil. Edition 1860, page 742, par. 834.

until she fell into a violent passion and the child, being suckled soon afterward died in convulsions. He was sent for hastily to see another child in convulsions, after taking the breast of a nurse who had just been severely reprimanded; and he was informed by Sir Richard Croft, that he had seen many similar instances; three others are recorded by Burdach (Physiologia. § 522) . . .

78 Another case was that of a puppy, which was seized with epileptic convulsions, on sucking its mother after a fit of rage. (22)

79 The case of the puppy indicates that in the brute creation results from anger, &c., will be produced upon the milk similar to those enumerated as the effected in the human subject and detailed in pars. 75, 76, and 77.

80 That the improper treatment of cows effect the milk is well known. (23)

We are now prepared to discuss.

81 *The limit and extent of the information derived from such examinations*, (pars. 29 and 32.)

82 We will commence with a resume of what can be accomplished.

83 By chemical analysis we can determine the amount of fatty matter, (butter) sugar of milk, caseine. (cheese), mineral substances, and volatile matter, (mostly water) from which facts a correct judgment of the commercial value of the milk can be formed, also if the milk has been skimmed, or watered, or both, or adulterated with chemicals (par. 2 to 11)

84 The microscope is serviceable in detecting if the colostrum (the milk secreted during the first few days after calving) is mixed with the true milk, or if it contains blood or pus from actual ulceration of the mammary glands. (par. 21.)

85 Some methods of partial examination of milk are of service in guiding us in forming a *probable conjecture* of the character of a specimen of milk (pars. 53 to 81) but in order

(22) Carpenter's Human Physiology, Phil. Edition, note on pages 742 and 743.

(23) Johnston's Agricultural Chemistry, Lecture XX. Encylopedia Britanic. Vol. XV. page 73.

to form a positive opinion a partial chemical examination is necessary, in which the amount of solid matter, and the fatty matter therein are determined; furthermore, in many doubtful cases, the determination of the quantities of sugar and caseine would be necessary.

86 Chemical analysis, which is so delicate in the detection of almost infinitessimal quantities of some substances, enables us to find in the milk certain materials which have been fed to the animal, but totally fails to show us in what is the peculiar change (or even any in most cases) that milk undergoes through the influence of fear, anger, some articles of food, &c., &c., upon the animal secreting it, changes that are deadly to the young that may use the
87 milk (pars. 73 to 79). In further illustration on this point, we have the fact that as yet no one has discovered a chemical or microscopic means for detecting when the suttle poison producting "milk sickness" is in the fluid, although the poison is so violent as soon to effect the strongest men who take the milk. ([24])

88 The detection that milk is from a diseased cow is not in the majority of cases accomplished by any method of examination, such influences frequently rendering (by the indications of analysis) the milk richer as shown by Vernois
89 and Bacquerel. In one case the milk of a consumptive cow gave the enormous amount of 10.73 per cent. of fatty matter in the milk. ([25])

90 From the facts enumerated in pars. 73, 83, 84, 86, 87, 88 and 89, we derive the important conclusion that, *Although chemical analysis, and microscopic examinations have failed to detect any deliterious quality in a specimen of milk, or may*

(24) My father (the late Prof. John Locke, M. D.,) devoted considerable time to the chemical microscopic, and botanical investigation of this subject, without any positive results excepting a full conviction of the vegetable origin of the disease.

(25) The composition of the solid matter from the consumptive cow was as follows:

Caseine	10.13	percentage of the milk.		
Butter	10.73	"	"	"
Sugar	4.09	"	"	"
Total solid matter	24.95	"	"	"

See Watt's Dictionary of Chemistry, (London 1868) Vol. III. pages 1018 and 1021.

even indicate it to be of a superior quality, we can not, therefore, conclude that the milk is a pure and healthy article.

91 In the recent report upon the milk furnished consumers in New York City, such a conclusion has been drawn, but we must most earnestly protest against the same or its use as precedent, with such a mass of evidence in opposition thereto.

92 I have no where been able to find the results of a series of experiments to determine the effects of food, want of proper care and cleanliness of cattle upon that subtle character of the milk beyond the reach of chemistry, and only to be determined by the effects upon young animals.

93 The effects of proper care and cleanliness have never for a moment entered as an element in the extensive experiments in Holland, as the washing and rubbing down of the cows, the roomy stalls of dressed lumber scoured to whiteness, the tieing up of the cows' tails to prevent the soiling of the animal or the stall, all of which have been so amusingly described by Washington Irving in his account of the village of Brock, "the Dutch Paradise." ([26]) with no exaggeration as I know from personal observation; and our cleanest dairies admit of no comparison with those of Holland.

94 From the experiments of Parmentier and Deyeux, the effects of rag weed, wild garlic, madder, saffron and many medicines, (pars. 64, 68 and 69) we are led to the inference that as a general rule *the milk of an animal carries with it in a greater or less degree, the peculiar characteristics of the food.* Therefore milch cows should not receive any article of food which possessed deliterious properties to man, old or in infancy. The effect of the food upon the cow being no proper criterion as shown in pars. 66 and 68.

CONCLUSION.

95 Having had no information upon the origin of the specimens of milk placed in my hands for analysis, but being fully aware of the active agitation in regard to the sources,

(26) See Wolfert's Roost, chapter "Brock, the Dutch Paradise."

&c., of the milk vended in the city, it is but natural that I should have concluded I was expected to show that one or more of the specimens were of a more or less injurious character.

96 In this chemistry and microscopy have necessarily failed, for the reasons that have been above enumerated, (pars. 73, 19, 21, 84, 86, 87, 88 and 89), which reasons corroborate the statements (which I have understood are made) that *filthy cows fed upon distiller's slops in dark confined and badly ventilated stables*, have furnished as rich milk, tested by analysis, as cows more humanely kept. This admission is so at variance with one's first impressions as to justify a short resume of the reasons and corresponding references upon which it is based.

97 1st. The skin of such animals have the pores closed with filth thereby requiring the other secretatory organs to do their duty (as is well known) in the removal of various matters from the system.

98 2d. The cows being quiet but comparatively little carbonaceous substance is thrown off by respiration, which mode of consumption of carbonaceous matter is further diminished by the confined atmosphere and want of light.

99 3d. This retained carbon increases the yield of sugar and buttery matter in the milk. (par. 71).

100 4th. The food given the animals is stimulating to the mammary glands (par. 65) enabling them to do the work for the lungs and skin, for if these glands do not remove the carbon, &c., it is laid up as fat on the animal, as is shown when the cow ceases to give milk, (27) and by the practice of fattening fouls in the dark, (28) but more accurately by Mr. Morton's experiments upon sheep. (29)

(27) Johnston's Agricultural Chemistry Lecture, XX. p. 551. The author after speaking of keeping cows in milk by brewer's slop, etc. says, "as they cease to give milk, they generally lay on fat in its stead."

(28) Johnston's Agricultural Chemistry Lecture, XXI. p. 609, note.

(29) Johnston's Agricultural Chemistry Lecture, XXI. p. 610.

CONDITION OF THE SHEEP.	INCREASE FOR EACH 100 LBS. OF TURNIP FED.
Unsheltered	1.2 lbs.
In open sheds	2.0 lbs.
In open sheds, but confined in cribs	1.8 lbs.
In a close shed in the dark	3.1 lbs.
In a close shed in the dark, but confined in cribs	2.4 lbs.

101 From what we have seen of the proneness of milk to acquire a subtle power, often more or less poisonous, and beyond detection by the chemist: (pars. 86 and 87) it would be almost incomprehensible if milk obtained by such violations of natural laws, and instinct, did not retaliate upon the unsuspecting consumer.

I have the honor to be sir,

Your most obedient servant,

JOSEPH M. LOCKE.

TABLE I.

Giving the Constituents in Grammes of 1000 Cubic Centimetres, of each Specimen of Milk.

1000 Cubic Centimetres=1 Litre=1.76 Pints.

1 Gramme=15.438 Grains.

Laboratory Number, of the Specimens of Milk.	Constituents of 1000 c. c.=1 Litre=1.76 Pints of Milk.					TOTAL Solid Matter in 1000 c. c. or 1 Litre or 1.76 Pints.	Mineral Substances in 1000 c. c.		TOTAL Mineral Substances in 1000 c. c. or 1 Litre, or 1.76 Pints.	Specific Gravity	REMARKS, &c.
	Volatile Matter, mostly Water.	Matter soluble in Either, i. e. Pure Butter	Matter soluble from dried Milk by hot water		Casein or Curds, i. e. Cheesy Matter.		Portion insoluble in Water, mostly Phosphate of Lime.	Portion soluble in Water, mostly common Salt.			By moving the decimal points in this table one figure to the left, we have the indications in PER CENT.
			Sugar of Milk.	Other soluble Substances.							
345	903.03	40.03	33.33	12.81	39.40	125.57	4.95	1.05	6.00	1029	This specimen had very slight acid reaction.
346	910.80	29.52	32.42	16.96	43.30	122.20	4.75	2.55	7.30	1033	This specimen had decidedly acid reaction.
347	902.80	30.87	34.29	13.59	48.45	127.20	4.85	2.40	7.25	1030	This specimen had acid reaction.
348	909.95	29.19	33.33	10.69	48.09	121.30	4.80	3.50	8.30	1033	This specimen was neutral.
349	891.55	49.50	31.58	14.07	44.30	139.45	4.75	2.60	7.35	1031	This specimen was neutral.

TABLE II.

Giving the Constituents, in Grains, of one American Standard Quart of each of the Specimens.

1 Quart=14993.05 Grains of Distilled Water at 40° F.

Laboratory Number, of the Specimens of Milk.	Constituents of 1 Quart of Milk.					TOTAL. Solid Matter in 1 Quart.	Mineral Substances in 1 Quart.		TOTAL. Mineral Substances in 1 Quart.	Specific Gravity.
	Volatile Matter, mostly Water.	Matter soluble in Either, i. e. Pure Butter	Matter soluble from dried Milk by hot water		Casein or Curds, i. e. Cheesy Matter.		Portion insoluble in Water, mostly Phosphate of Lime.	Portion soluble in Water, mostly common Salt.		
			Sugar of Milk.	Other soluble Substances.						
345	13177.96	584.16	486.39	186.94	574.97	1832.45	72.24	15.32	87.56	1029
346	13291.35	430.79	473.11	247.50	631.88	1783.28	69.32	37.20	106.52	1033
347	13174.61	450.49	500.40	198.32	707.03	1856.24	70.78	35.02	105.80	1030
348	13278.95	425.97	486.39	156.00	701.78	1770.14	70.04	51.07	121.12	1033
349	13010.43	722.36	460.85	205.32	646.47	2035.00	69.32	37.84	107.16	1031